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ABSTRACT

The author presents guidelines for the selection of statistical analysis software given to graduate students to work independently. Criteria for a good teaching program are delineated. Several software programs are evaluated: STATMASTER, Statistics and Probability, Monte Carlo Simulations, Survey Sampling, KEYSTAT, CAPSAS: Computer Assisted Program for the Selection of Appropriate Statistics, EDA: Exploratory Data Analysis, INTROSTAT, Statistics With Finesse, STATPAC, GANOVA: Generalized Analysis of Variance, Speedstat, Micro-DSS/Analysis, and Micro-TSP. Several statistics packages are briefly reviewed, including STATPRO, A-STAT, Computer Models for Management Science, Multiple Factor Analysis, a General Correlation Program, and Test Construction Package. An appendix lists criteria for evaluating software. Demonstration pages prepared with a TEXPRINT printer interface card in the APPLE II+ computer are included. (DWH)

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EVALUATING MICROCOMPUTER PROGRAMS

for

CLASSROOM AND LABORATORY USE

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TM 840 267

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A.E.R.A. Convention
April 27, 1984

EVALUATING MICROCOMPUTER PROGRAMS for CLASSROOM and LABORATORY USE

April 27, 1984

Attempting to evaluate microcomputer software today could be an endless task. Microcomputer technology is changing rapidly, allowing problems very recently considered to be "mainframe" only to be processed with reasonable speed and accuracy on micros. New and improved software, some of it very significant subsets of mainframe packages such as S.P.S.S., B.M.D.P., and MINITAB, are becoming available for microcomputers faster than ever before. Further, we are dreaming up and trying out new uses of micros that even three or four years ago had not been seriously considered.

The first cut in deciding which programs to evaluate and how is to consider what a microcomputer program is to be used for. Basically, there are three different sets of possible needs to consider:

1. Teaching Probability and Statistics in the classroom.
2. Helping students learn Probability and Statistics on their own.
3. Getting significant statistical research work done.

For purposes of this paper, we will not pay attention to the last of these, noting only that there is some overlapping use of software for more than one set of these needs, and that criticisms applied in the context of the first two sets of needs may not be applicable for production work. (The user with work to do may find the articles by Jordan (4), by Carpenter, Deloria, and Morganstein (2), and by Swaine (6) of interest.)

The second cut in selecting programs was the practical one of their useability on APPLE II+ compatible computers. Aside from the fact that the author owns two of them, the APPLE II+ has several very useful attributes, including:

40-column screen capability for better legibility in class use.
Standard video signals for interfacing with existing A-V equipment.
Easy interface with other computers for networking.
Extensive library of available programs.
Relative portability for taking to class.

The third cut, again practical, was simply that of finding out what was available and trying to acquire it, at least temporarily, with limited funds. This in itself poses a problem since the programs tend to be too expensive for one person to buy very many of, "free" examination copies of software is difficult to arrange, and "demo" disks rarely allow a fair and full evaluation of a product. The author is indebted to many companies who have made their software available under special arrangements, and to colleagues who had access to software the author did not. It should be noted in this context that some very interesting software is not commercially available; word-of-mouth communication has brought it to light.

The next cut has been brought about by the lack of microcomputer equipment readily available to students, although that is beginning to change. Less emphasis has been placed on, and there is less experience with, software designed to help a student learn on his own. More has been placed on software that appears to help the teacher conduct classwork in a fairly traditional setting.

The last cut has come about because of the time it takes to

do a complete evaluation job on software. Some of the software whose features are mentioned below was selected because it was of sufficient interest to the author to gain a time priority.

Consequently, no claim to completeness can be made. This paper will have served its purpose, however, if readers are assisted in finding software that is "just right" for them, and, following the grapevine route for advertising, if additional useful and low-cost software comes to light for future evaluation and publicity. It may also serve a purpose if the criteria developed are refined and used for selection and future creation of software in tune with classroom and laboratory needs.

Within the above limitations, what makes for good software? Appendix I outlines criteria we have used; other sets of criteria have been presented by many authors, inlcuding Blum (1), Hsu and Nitko (3), and Lachenbruch (5). In general, for software to be given a student for unattended use we look for the following:

1. It will be clear to the student what to do.
2. The student will be guided towards finding an answer rather than being given one.
3. A student's mistakes can be corrected without aborting the program.
4. The student is appropriately rewarded for successful work.

A good teaching program (for the classroom) will have the following:

1. Data can be prepared in advance or entered when needed (at the teacher's option).
2. The software can be run with a minimum number of keystrokes.

3. Keying errors are easily caught and corrected.

4. Screens can be stopped, held for discussion, and, preferably, recalled for review.

5. A problem can be re-run with minor changes in the data without rekeying the entire set of data.

Software Summaries

STATMASTER: Workbook and disk published by Little, Brown and Co.

Intended to guide the student in such activities as placing points on a plot and estimating the Pearson product-moment correlation. With some trouble, a teacher may capture the high-resolution page as a disk file for classroom "slide-show" presentation. In some circumstances, might be appropriate for actual use in class. Demonstration page shows the menu, guessed and actual correlation for 3 points, instruction to student for placing additional points.

STATISTICS AND PROBABILITY by Trumbo: Software available from COMPress, Wentworth, New Hampshire.

Outstanding graphics at an unfortunately high price. Not clear from the demonstration disk, which is uneven in quality, how much control the teacher has over what is displayed, and whether some of the graphic material might be interspersed with more traditional text (e.g. table) material. Demonstration page shows a graph of Chi-Square observed vs expected in a 3 x 3 table, the location of an obtained Chi-Square statistic in its distribution, and the Normal curve fit to a Binomial distributionl

MONTE CARLO SIMULATIONS: Software and manual available from Actuarial Micro Software, 3915A Valley Court, Winston-Salem, N.C. 27106

This software will create random samples from a number of distributions, including Normal, Log-normal, Uniform, Pareto, Binomial, Negative binomial, and Poisson. It will test generated samples, or a set of data that has been keyed in, against a designated distribution, indicating with a well-tailored graphic display whether or not the fit is "good." It would be helpful to know the criteria for a "good" fit, and perhaps have an actual Chi-Square and probability given. Source code is available. Data may be stored on or read from disk in D.I.F. format for use with spreadsheet or other programs using that format. The demonstration page shows a typical real vs theoretical comparison.

OFF-LINE Regression Equations and Predictions: One in a series published by Micro Power and Light, 12820 Hillcrest Road, #224, Dallas, Texas 75230

Some parts of this series are deliberately aimed below the college level, and would probably move too slowly for use at higher levels. OFF-LINE, however, appears most useful, developing a trend line, a linear fit to the trend line, the regression equation of both y with x and x with y, distances from the regression line, and "error." Although intended for individual student use, including quiz questions that indicate whether review or moving forward is desirable, open program and good graphics make this a fine program for teacher use also. The demonstration pages show the objectives, the initial data scattergram, the trend line, a straight line approximation o the tend line, closeness of fit of trend to straight line, correlation as measure of overlap, both regression lines, and the distances from actual to predicted points.

SURVEY SAMPLING: distributed by CONDUIT

Describes an attitude survey to be taken from a population and various sampling strategies available. A sample of chosen size is selected by the strategy chosen and summary statistics plus cost are presented. Population parameters are available upon request. The user needs to write down intermediate results that the computer should be able to keep track of. Rather slow, especially if a large sample is requested. Random samples using the same strategy are quite different. Difficult to interrupt the program to save a screen and continue from that point; a restart will not produce the same result up to the point of interrupt. Demonstration page shows the random sampling explanation and sample size selection, actual selection of the sample, and graphic display of the results of that sample.

KEYSTAT: Software and text/workbook published by Brooks/Cole Division of Wadsworth Publishing.

The student is guided in the selection of the correct statistic to use (with not all alternatives provided for, at least on the demonstration disk), or may choose the statistic to use directly. Written material is competently done; there has been no opportunity to test the actual computations or to see the displays. From the available evidence, this looks like a good candidate for statistics laboratory work, not as useful for classroom use. Demonstration page includes menu and results of a SELECT process.

CAPSAS: Computer-Assisted Program for the Selection of Appropriate Statistics. In final test stage, to be available from University of Michigan (Institute for Social Data Analysis).

This is a somewhat slow but thorough guide to the selection of the correct statistical procedure(s) for conditions specified by

the user. Help material, including explanations of key words the user is asked to select among, is readily available. Whether this is a companion piece to or substitute for similar printed material from the same source remains to be seen. For classroom use, however, the screens allow focusing of attention on the decision at hand, and review of the pertinent definitions. Runs in 40 column mode, but requires lower case capability. Very hard to save a screen to disk. Demonstration pages show the decision tree from start to finish (more than fits on one screen) with a help screen inbetween.

STATPOWER (Later version known as SAMPLECALC): Software published by Abt Associates, Cambridge, Mass.

The student is carefully guided through assumptions and risks to determine the minimum sample size needed. The later version also provides some tutorial material. The final display shows not only the sample size for the selected conditions, but how that sample size would change as minor changes in conditions are made. Unfortunately for teaching purposes, use is made of an uncommon statistic, D, effect size, that can be calculated from additional questions to the user, but whose properties are not immediately obvious to the beginning student. Demonstration page shows typical questions and prompts, feedback as to the consequence of what has been selected, and presentation tableau.

EDA: Exploratory Data Analysis. Software package available from CONDUIT.

This software follows the book and does a fine job. Unfortunately, there appears to be no provision to get existing data in from an external machine-readable file, although source programs are available, and a good programmer with time might be able to build an interface. (It may someday be useful to examine the data file structure of this and other programs and build a "front end" to convert existing files to the correct format). Demonstration page shows the Stem-and-Leaf display, and the Boxplot with outliers.

INTROSTAT: Software and manual published by Ideal Systems, P. O. Box 681, Fairfield, Iowa 52556

Open programs designed for classroom and laboratory use, including a sample data set adapted from "STATLAB: An Empirical Introduction to Statistics" (Hodges et al, McGraw-Hill, 1975). Data does need to be previously entered via the Data File Management program. Significances are not computed in the version supplied, but apparently could be added to the programs by a user with time and inclination. One disk with room on it for small data sets is an operational convenience. Demonstration pages show the main menu, the correlation/regression menu, the regression results, and the scatterplot with regression line in the process of being drawn.

SPS: Statistical Processing System, available from G. J. Buhyoff, Associate Professor of Biometrics, V.P.I., Blacksburg, Virginia (Manual and 2 disks)

The comprehensive manual includes much more than operating instructions; algorithm source and analysis of statistical accuracy, for example. Data must be previously entered and stored on a separate disk. Most commonly used programs are on one disk, seldom used programs on another. Full file interchange between SPS format and both standard text and D.I.F. formats is available. This looks like a real workhorse program for both laboratory and real data analysis. Demonstration pages show the main and file maintenance menus, a simple plot, selection and calculation of the correct type of correlation coefficient for test data (including significance), and a simple correlation matrix.

STATISTICS WITH FINESSE: Software package available from James Boulding, P.O.Box 339, Fayetteville, Arkansas 72702

The most commonly used routines are available on one disk for keyboard use only, which contains listable source programs. The main package comes on 6 disks, and is compiled (and includes item analysis routines). Entry and editing of data from the keyboard is quick and easy for class and textbook examples. In the keyboard only version there is no way to transfer a set of data from one procedure to another. Graphic display of data does not appear to be available. Execution is swift and output is neat, with decimal points lined up. The demonstration sheet shows the keyboard-only version of Pearson Product-Moment correlation, including 1-tail significance.

STATPAC: Carl F. Berger, the author, others. The major portion is available from the University of Michigan School of Education.

This is an informal collection of useful programs written with a "quick and easy" philosophy intended primarily for classroom demonstration purposes. Essentially, there is no documentation; the user has to know what is available and how to use it, although in many cases prompts are used. Significance is calculated. The demonstration sheet shows the confidence interval for a correlation coefficient and its test against zero.

GANOVA: Generalized analysis of variance program available from Mary-Lynn Brecht or J. Arthur Woodward, Department of Psychology, U.C.L.A.

This program allows complicated ANOVA designs, and comes with good tutorial problems. It is a refined version of software used in a mini-workshop at the A.E.R.A. Convention in Montreal in 1983. It is intended as a stand-alone program, although separate data creation subroutines make the data format explicit and would facilitate a computer-literate user getting existing data in. Significances are calculated and shown. The demonstration sheet

shows typical user interaction with a small tutorial problem.

SPEEDSTAT: A series of software packages available from SoftCorp International, Westerville, Ohio, 43081.

SPEEDSTAT 1 (Frequencies and crosstabs) and SPEEDSTAT 2 (Correlation and Regression) are now available, with additional volumes planned. This package is included partly because of the helpfulness of the company in working problems tshrough, partly to illustrate strengths and weaknesses of commercial products. Accuracy is excellent; menu selection is fast and easy. Features for data editing are useful. However, 3 disks are needed: Program disk, work disk, and data disk (which allows only 1 data set per disk). The data set used can be quite large. Results are intended to be printed, not displayed on the screen; screen display, in fact, steps the user through very small portions of the results to be printed. Printed format is excellent provided it is what you want; one example produced 19 pages of useless output to get the 1 page that was useful. Although D.I.F. input format is advertised, there have been difficulties when variables had different decimal alignments (e.g. ID number with no decimal places and a variable with one unit and 3 decimal places). It is not easy to get data out for use in any other program. It is not easy to save screens for teaching purposes. Demonstration sheets show the Frequencies/ Crosstab menus, data summary, and a very small part of the intended printed output.

MICRO-DSS/Analysis: Software and manuals published by Addison-Wesley, Reading, Mass.

An over-priced program that has good file maintenance and rapid execution (compiled Pascal), with good graphics, and good report preparation for display of input data (e.g. cross-footing, percents). Help menus are available. The statistics section, however, is disappointing and recommendations have been made to the publisher for upgrading of this portion of an otherwise nice package. Data exchange with other programs does not appear to be supported. The demonstration sheets show parts of the tutorial session with store data including a rather tricky graphic display of store age by region.

MICRO-TSP: Software and manual/text available from McGraw-Hill.

This is by far the best time-series tutorial and learning package this author has yet seen. (It is not for the neophyte, however.) It is expensive, but may well be worth the price. Multiple regression features, independent of time series applications, are the best yet seen in any package. Data interchange in standard disk formats, and saving of results for entry into other packages is facilitated. Long strings of commands may be set up for exceution untended. The regression coefficients are available automatically for entry into new data transformations if desired. Unfortunately, the apparent excellence of this product is offset

by the apparent unwillingness of the vendor to respond in any way to any communication about the package except to ship the demonstration disk for the advertised price. The demonstration sheets show a general introduction, the demonstration workfile configuration, a list of some of the data and a transformation of part of it, a quick graphic display, the residual plot, and a statistical summary.

HONORABLE MENTION

Several statistics packages have been made available to the author but have not been commented on in detail. These will now be mentioned in passing:

STATPRO: (Wadsworth Software Publishing.) A good, complete stand-alone workhorse package at an exhorbitant price, even with educational discount. Use of 80-column screen, inability to get data in or out except by rekeying, and inability to hold and repeat results make this package a very poor candidate for classroom or laboratory use.

A-STAT: (Rosen Grandon Associates.) This package of long standing has been updted. Factor analysis is now included. Standard text files may be used. A very capable package for getting work done.

COMPUTER MODELS FOR MANAGEMENT SCIENCE: (Addison-Wesley.) Text and software that includes Bayesian Probabilities and Decision Analysis that may be of some interest in statistics. Excellently done.

MULTIPLE FACTOR ANALYSIS: (Mathematical Software.) Appears to use the Centroid method only. Slow. Other alternatives appear to be more useful.

A GENERAL CORRELATION PROGRAM: (Moore-Barnes Company.) Carefully constructed programs to calculate the correct correlation coefficient for psychological data. Some of the statistics do not appear to be available in any other microcomputer package. The major problem is relatively high level of familiarity with the microcomputer needed to use the program successfully.

TEST CONSTRUCTION PACKAGE: (Noore-Barnes Company.) The test item statistics one would expect (difficulty, variance, item-total and item-criterion correlations) as well as test and scale statistics are available. Relatively high level of sophistication in the use of a microcomputer again makes this program difficult to use in the classroom / laboratory situation.

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The demonstration pages which follow were prepared using the TEXPRINT printer interface card in the APPLE II+ computer. One push of a button and whatever is on the screen appears on the printer.

References:

1. Blum, Vicki L. EVALUATING INSTRUCTIONAL SOFTWARE FOR MICROCOMPUTERS: AN ANALYTICAL EVALUATION PROCEDURE. Paper presented at the Annual Convention of the American Educational Research Association, New York, N.Y., March, 1982.

2. Carpenter, James, Deloria, D., and Morganstein, D. "Statistical Software for Microcomputers." BYTE Magazine, April, 1984, p. 234-264.

3. Hsu, Tse-chi, and Nitko, Anthony J. "Microcomputer Testing Software Teachers Can Use." EDUCATIONAL MEASURMENT: ISSUES and PRACTICE, Winter, 1983, p. 15-30.

4. Jordan, Eleanor W. SELECTING STATISTICAL PACKAGES FOR MICROS: PROCESS STEPS, FEATURES, and LIES. Paper presented at the Annual Convention of the American Institute for Decision Sciences, San Antonio, Texas, November, 1983.

5. Lachenbruch, Peter A. "Statistical Programs for Microcomputers." BYTE Magazine, November, 1983, p. 560-570.

6. Swaine,Michael. "Can You Do Statistics on a Microcomputer?" INFOWORLD, V.5, No. 46 (Oct., 1983) p. 39-45.

APPENDIX 1

CRITERIA FOR EVALUATING SOFTWARE October 12, 1983

A thorough software package evaluation will include all of the following which apply.

I. What does the package do?
   a. Stated uses.
   b. Additional or side uses.
   c. Equipment requirements.

II. What is the appropriateness of the package for the job to be done?
   a. For instruction: How does it fit in the curriculum? How does it contrast with alternative ways of getting the same material across to students? What range of potential objectives might this package meet?
   b. For administrative or research work: Is this a good way to get a job done? - as against other alternatives?

III. How well does the package do its job?
   a. Accuracy of results.
   b. Protection against or easy recovery from keying mistakes.
   c. Ease of operation.
   d. Quality of displayed/printed results.
   e. Speed of operation.

IV. How well documented is the package?
   a. How easy is it to learn to use?
   b. Are details of what the program does and how available?
   c. Is a quick reference available for the experienced user?
   d. Does the user have the ability to make changes to customize the package?

V. How well is the package supported?
   a. User assistance: telephone contact? Mail contact?
   b. Community of users: who else knows about the package?
   c. Policy on updates, corrections, improvements?
   d. Response to special requests?
   e. Is the program "open" so it can be modified?

VI. Data entry and manipulation:
   a. Can data be entered from standard text files? - DIF files?
   b. Can data be edited, errors corrected, added to (variables and cases)?
   c. Can "What If" questions be asked without totally rekeying the data? - minor changes, temporary or permanent...
   d. Can data, once entered, be used with more than one procedure? Can it be saved as a standard text or DIF file for use in other software?

VII. Output manipulation:

a. What is on the screen? - enough to show something?
b. Can the screen be stopped and the problem later continued?
c. Can screens be scrolled back or repeated for teaching purposes? Can they be saved for later use?
d. Can the output be printed easily? - neatly?
e. Can the output be entered into other software - particularly word processors for report preparation?

V. Miscellaneous

a. Can the disk be copied for back-up purposes? Or, does the publisher make back-up copies available for a reasonable price?
b. Can the program run effectively on a single drive system? How much disk-shuffling does the user need to do?
c. How well is the user prompted, or given options, on the screen?
d. Is lower case used? - is it required?
e. Is there a choice between 40 and 80 column screen? If so, what shows on each?
f. What level of computer sophistication should a user have?

General considerations:

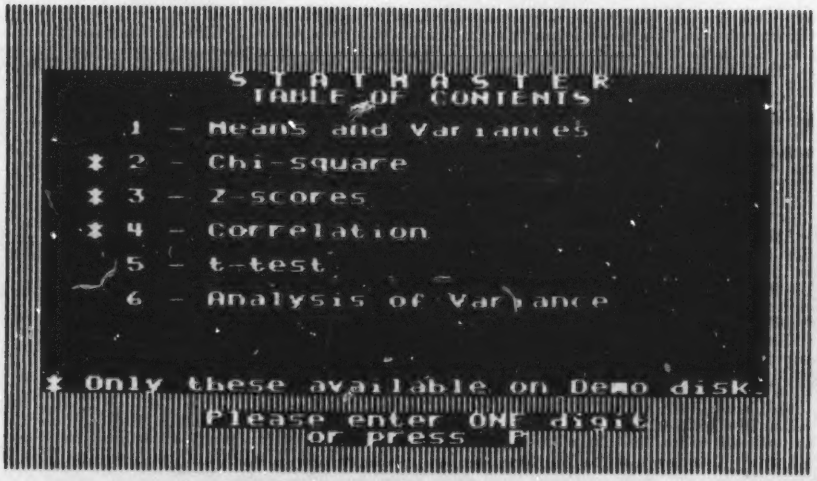
A software package generally is useful in at least 1 of 3 somewhat different situations:

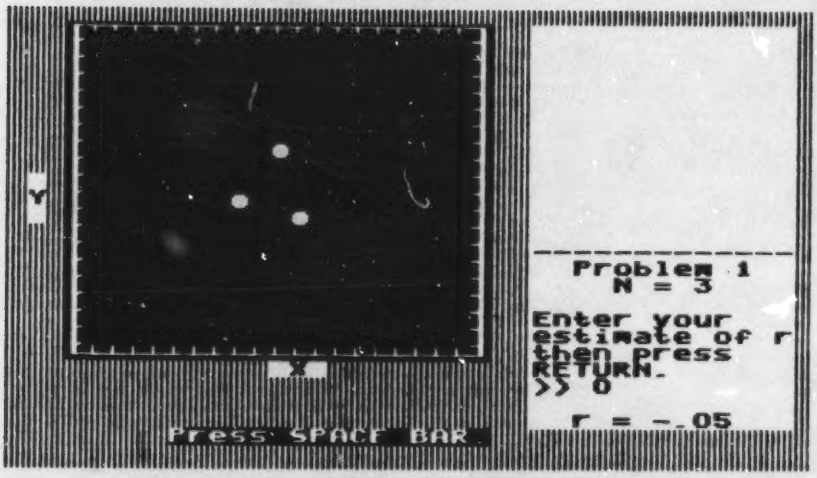
A. It helps a teacher conduct a class.

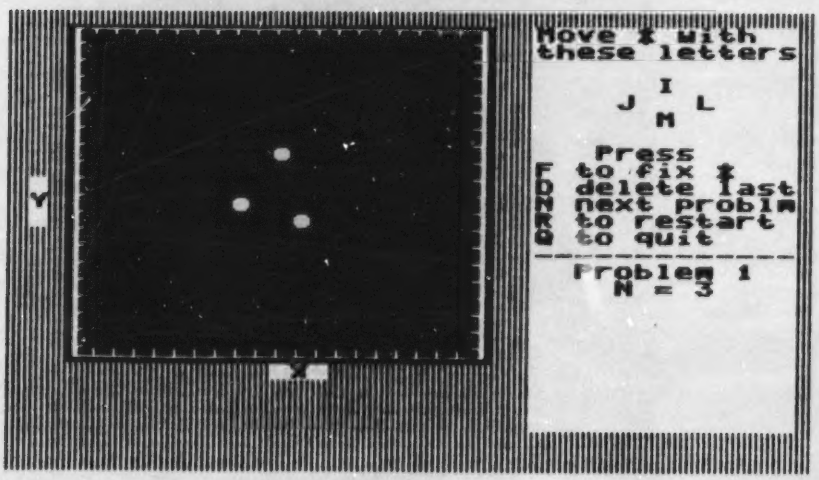
B. It helps a student learn something on his/her own.

C. It helps someone get work done - such as a repoort printed or an answer to a statistical problem.

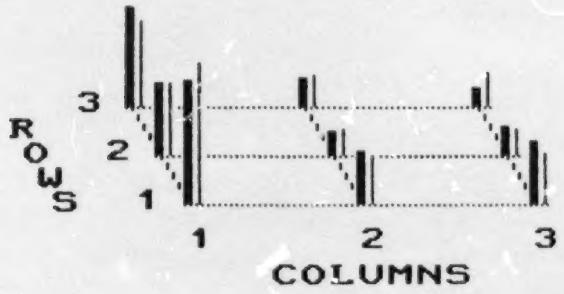
A potential user should know which, if any, of the sets of needs inherent in each type of use are met and how well, and what is required of the user considering this piece of software.

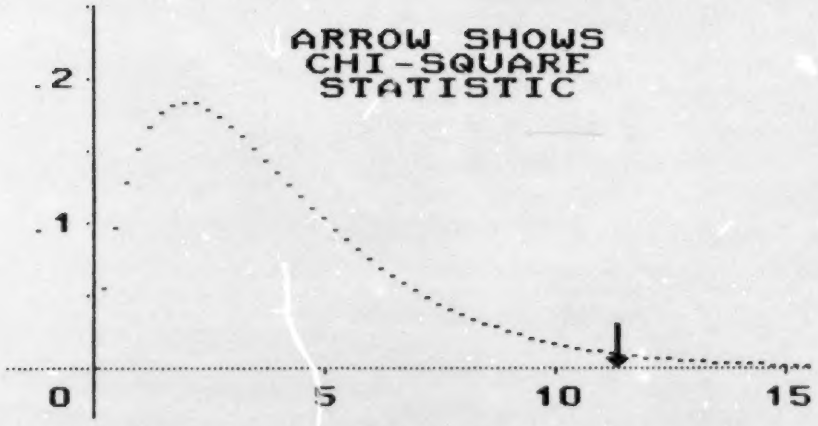

STATMASTER
TABLE OF CONTENTS
1 - Means and Variances
* 2 - Chi-square
* 3 - Z-scores
* 4 - Correlation
5 - t-test
6 - Analysis of Variance
* Only these available on Demo disk
Please enter ONE digit
or press P


Y
X
Press SPACE BAR
Problem 1
N = 3
Enter your
estimate of r
then press
RETURN.
>> 0
r = -.05

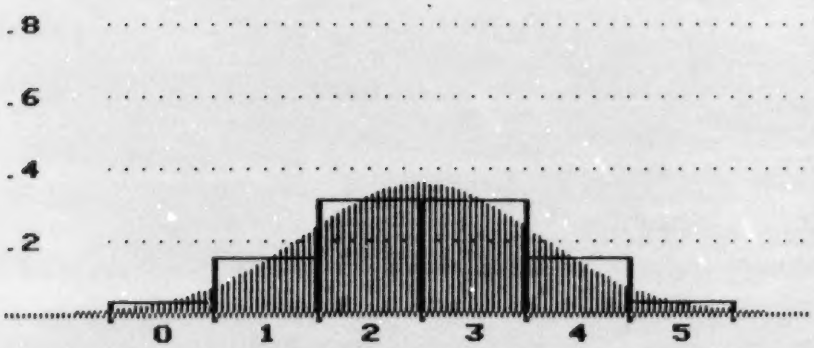

Y
X
Move * with
these letters
I
J L
M
Press
F to fix *
D delete last
RETURN next problm
R to restart
Q to quit
Problem 1
N = 3

GRAPH OF OBSERVED (THICK)
AND EXPECTED FREQUENCIES
SAMPLE SIZE N = 368



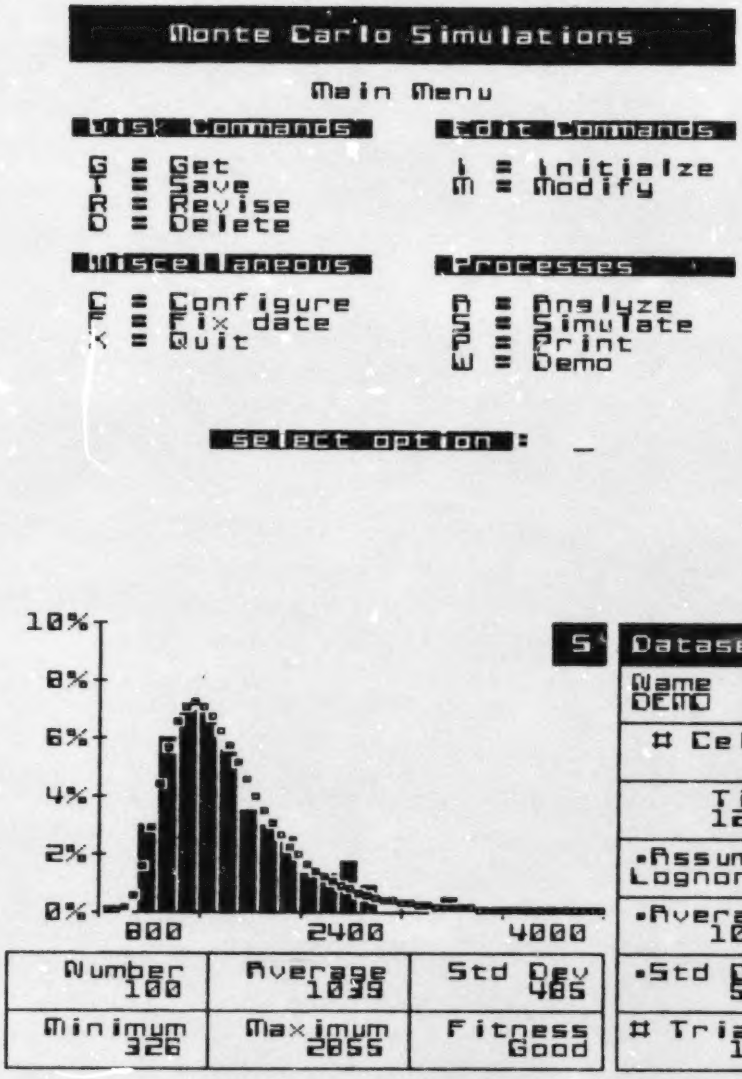


CHI-SQUARE DENSITY, DF = 4



BINOMIAL PLOT: N=5, P=.5
NORMAL FIT: μ=2.5, σ=1.12

Applied Statistics and Probability

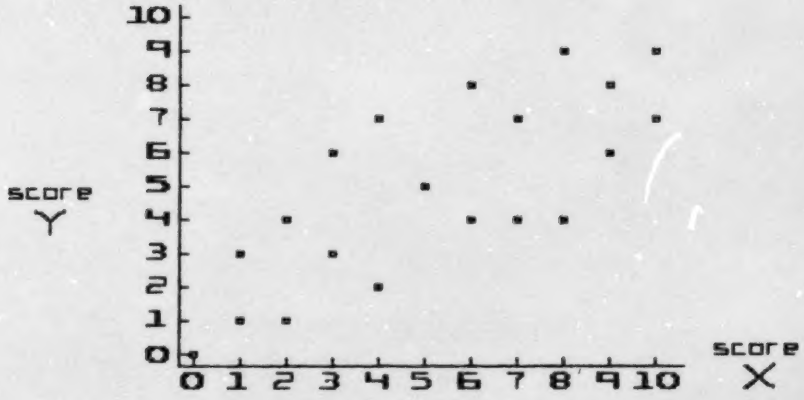


MONTE CARLO SIMULATIONS

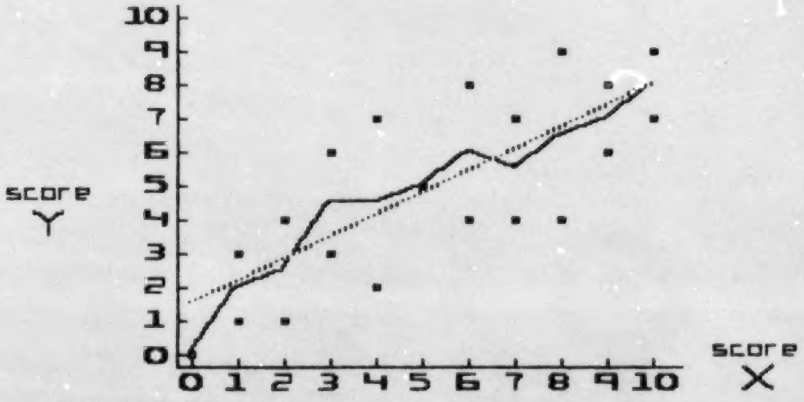
OBJECTIVES

IN THIS PROGRAM YOU WILL LEARN:

1. THE MEANING OF THE TERM 'REGRESSION'.
2. HOW CORRELATION AND REGRESSION ARE RELATED.
3. HOW TO USE THE REGRESSION EQUATION FOR MEASURING 'X Y' RELATIONSHIPS.
4. HOW TO DRAW A 'REGRESSION LINE' ON A SCATTERPLOT OF 'X' AND 'Y' SCORE PAIRS.

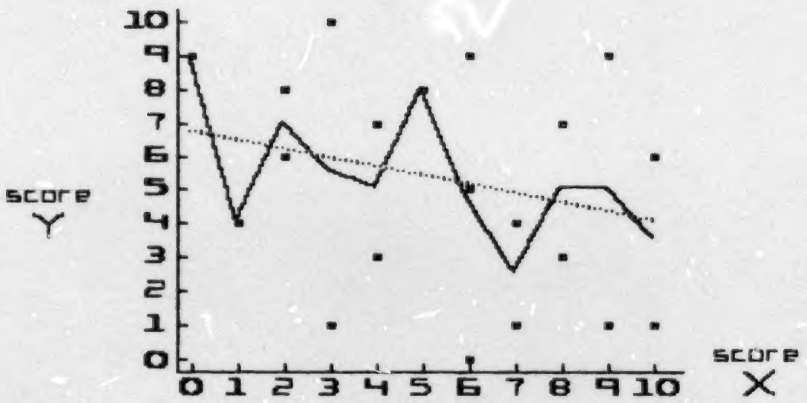


WE SEE A POSITIVE, FAIRLY STRONG LINEAR RELATIONSHIP ON THE SCATTERPLOT ABOVE.



A STRAIGHT LINE DESCRIBES THE TREND OR FORM OF THIS RELATIONSHIP NICELY, SO WE KNOW IT IS A LINEAR RELATIONSHIP.

OFF-LINE-1

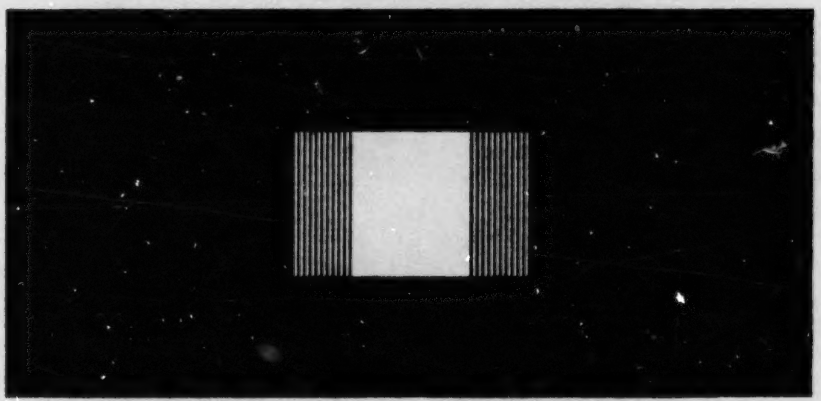


THE DEGREE OF LINEAR RELATEDNESS IS LOW OR NILL, AND THE 'STRAIGHT FIT LINE' TENDS TO PARALLEL THE 'X' AXIS.

REGRESSION: DEFINITIONS AND RATIONALE

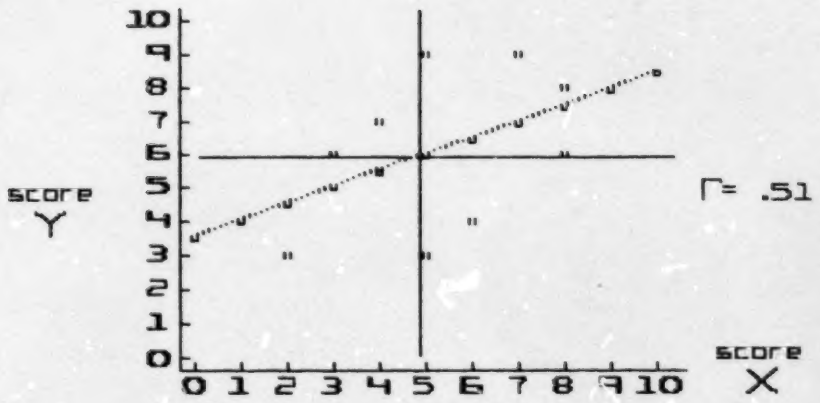
WHEN A 'TREND LINE' FOLLOWS A GENERALLY STRAIGHT LINE WE SAY THAT 'X' AND 'Y' HAVE A LINEAR RELATIONSHIP

TYPE T OR F:

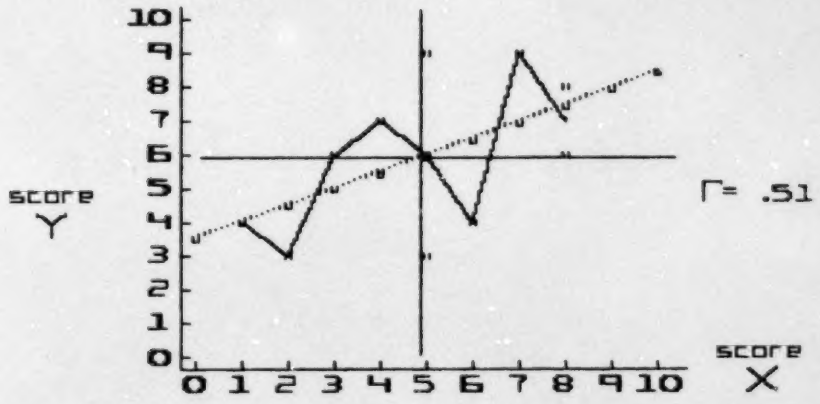


WITH HIGH CORRELATION AND OVERLAPPING VARIANCE, ONE'S 'X' SCORE 'POINTS TO' ONE'S 'Y' SCORE MORE ACCURATELY THAN DOES THE 'Y' MEAN ALONE.

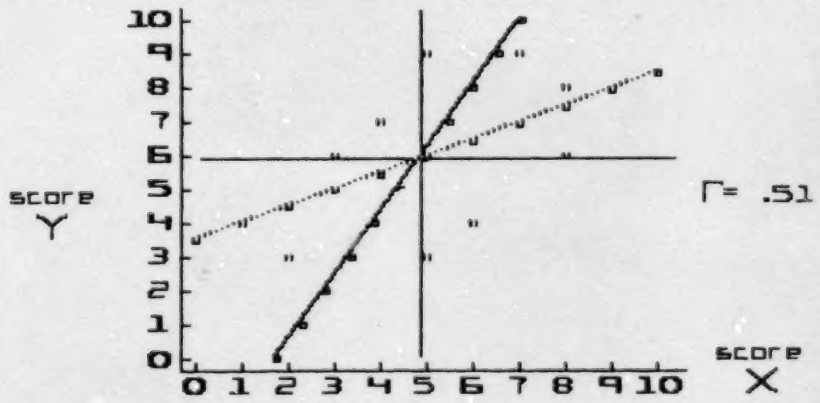
OFFLINE-2



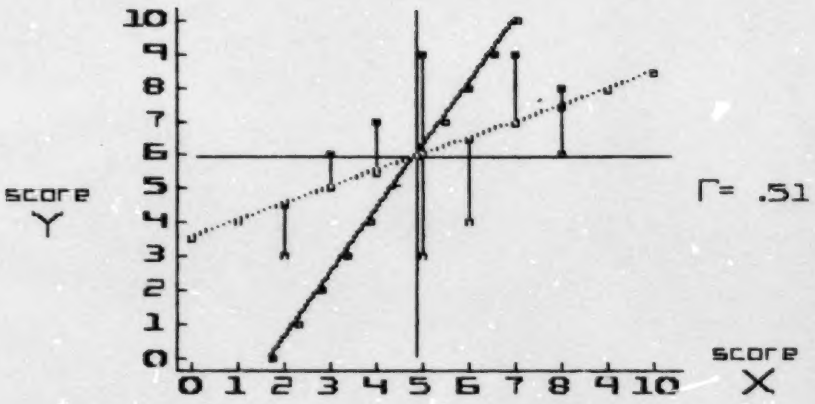
THERE IS AN INCREASE OF .49 IN 'Y'
FOR AN INCREASE OF ONE POINT IN 'X'.



NOTICE THE 'FIT' OF THE REGRESSION LINE
TO THE TREND OF 'Y' MEANS CALCULATED AT
EACH VALUE OF 'X'.



OFF-LINE-3



FIND THE TOTAL 'Y FROM X' PREDICTION ERROR AS THE SUM OF SQUARED ERRORS (SEE PLOT ABOVE) DIVIDED BY N - 1.

OFFLINE- 4

Simple Random Sampling

With this method, every resident on the voter registration list is given a case number. Then N (= size of sample) random numbers are obtained, the residents with case numbers corresponding to those random numbers are surveyed and their attitudes are recorded.

The attitudes are measured on the scale:

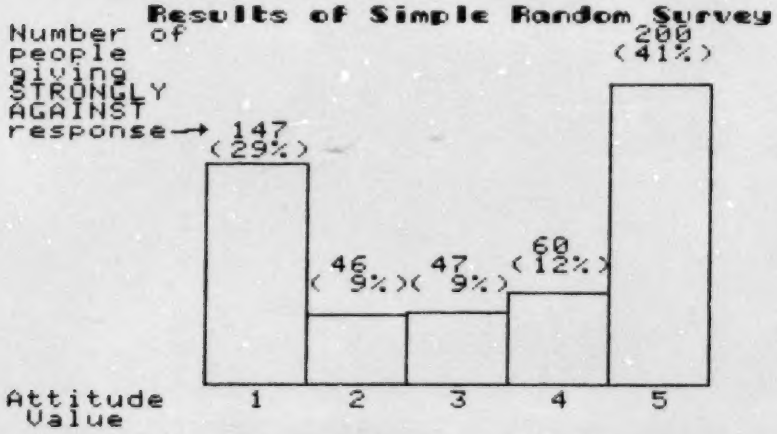
1 - strongly against
2 - against
3 - neutral or no opinion
4 - in favor
5 - strongly in favor of redevelopment

How many residents of Littleton do you want to include in your sample (type a number not more than 1104 and press **RETURN**)? _

Tabulation of the Results of a Simple Random Sample Survey of the Residents of Littleton (don't record this tabulation)

Respondent	Attitude Value
10803	5
1572	5
5496	5
3963	5
9670	4
8854	5
4829	5
2948	5
7073	5
5165	5
10533	5
1568	5
6419	5
10760	5
1101	5

End of tabulation. Wait while survey continues.



Press the **SPACE BAR** to continue. _

SURVEY SAMPLING

BROOKS/COLE PUBLISHING PRESENTS

KEYSTAT STATISTICAL PROGRAMS

```
 1 - SELECT STAT SELECTION AID
 2 - DESC   DESCRIPTIVE STATISTICS
 3 - CHI    CHI-SQUARE TESTS &
            CONTINGENCY COEFFICIENT
 4 - MC-C   MCNEMAR & COCHRAN TESTS
 5 - MEDIAN MEDIAN TEST
 6 - W-F    WILCOXON & FRIEDMAN TESTS
 7 - K-W    KRUSKAL-WALLIS TEST
 8 - T-TEST T-TESTS (CORR & UNCORR GPS)
 9 - AV1    1-WAY ANOVAS
10 - AV2    2-WAY ANOVAS
11 - AVCO   1- & 2-WAY COVAR ANOVAS
12 - SPEAR  SPEARMAN RANK CORR
13 - P-CORR PEARSON PRODUCT-MOMENT CORR
14 - ORDER  ORDERING INFORMATION


ENTER NUMBER? (1-14)
```

QUESTION	COMPARATIVE
DATA LEVEL	NOMINAL
NUMBER OF FACTORS	1
NUMBER OF GROUPS	2 - 8
RELATED GROUPS	NO
APPROPRIATE PROCEDURE	CHI-SQUARE TEST OF INDEPENDENCE
LOCATION	CHI (SEE P. 14)

```
INPUT (R) TO RUN 'CHI' PROGRAM
      (S) TO RERUN 'SELECT' PROGRAM
      (M) TO RETURN TO MASTER MENU

?
```


KEYSTAT

```
============:DECISION TREE:============

          Press ? for help menu.

 Trace:
 Enter option -->2
=======================================


How many variables does the problem
involve?

      1) One variable
      2) Two variables
      3) More than two variables


============:DECISION TREE:============

          Press ? for help menu.

 Trace:21
 Enter word -->DEPENDENT
=======================================


 DEPENDENT VARIABLE.  A variable which
the analyst is trying to explain in
terms of one or more independent
variables.  The distinction between
dependent and independent variables is
typically made on theoretical grounds-in
terms of a particular causal model or to
test a particular hypothesis. Synonym:
criterion variable.


      * Press any key to continue *
```


CAPSAS-1

```
============:DECISION TREE:============

          Press ? for help menu.

 Trace:2112*
 Enter option -->
=======================================


The statistical procedure which you have
              chosen is the
*     Coefficients from curvilinear      *
*                Regression              *
*               (b or beta)              *
*The  type  of  curvilinear  regression*
*referred  to  here  is  also  known as*
*polynomial regression.  See  SOME  NEW*
*OR RARELY USED STATISTICAL TECHNIQUES,*
*note 4.                                 *
The statistical test for this measure is
#                 F test                 #
#      (F equals t square for each       #
#               coefficient)             #
      * Press any key to continue *


============:DECISION TREE:============

          Press ? for help menu.

 Trace:2112*
 Enter option -->
================== <RET> to restart ===

*               (b or beta)              *
*The  type  of  curvilinear  regression*
*referred  to  here  is  also  known as*
*polynomial regression.  See  SOME  NEW*
*OR RARELY USED STATISTICAL TECHNIQUES,*
*note 4.                                 *
The statistical test for this measure is
#                 F test                 #
#      (F equals t square for each       #
#               coefficient)             #
#Assumptions  for  inferences based on #
#techniques   using   one    or    more#
# INTERVALLY   SCALED   variables  may#
#apply.  See CAUTIONARY  COMMENTS, note#
#5.                                      #
```

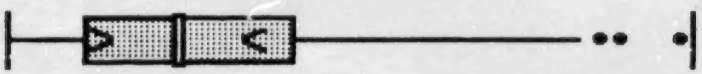
```
DO YOU PLAN

     (1) ONE SAMPLE OF N OBSERVATIONS?

     (2) ONE SAMPLE OF N DIFFERENCES
         BETWEEN PAIRED OBSERVATIONS?

     (3) TWO SAMPLES OF EQUAL
         VARIANCE?

     (4) TWO SAMPLES OF UNEQUAL
         VARIANCE?

PLEASE INPUT YOUR CHOICE:



BY SPECIFYING P<.05 AND POWER=.8,
YOU IMPLY THAT YOU CONSIDER TYPE I
ERROR TO BE 4 TIMES AS SERIOUS
AS TYPE II ERROR.

THAT IS, YOU ARE 4 TIMES AS AFRAID
OF FINDING SOMETHING THAT ISN'T THERE
AS OF FAILING TO FIND SOMETHING
THAT IS.

DO YOU WISH TO RECONSIDER? (Y OR N)
```

SAMPLE PER GROUP TO ESTIMATE THE DIFFERENCE BETWEEN THE MEANS OF TWO SAMPLES WITH ERROR TOLERANCE=5, SD=10 WITH 95% CONFIDENCE, 1-TAILED (D=ERROR/SD)

	EFFECT SIZE D		
POWER	.4	.5	.6
.75	68	44	31
.8	78	50	35
.85	91	59	41

```
Stem and Leaf display
   Unit = 1

   1      . 9
   3     1* 02
   6      . 889
  10     2* 1234
  10      . 7799
   6     3* 14
   4      . 78
   2     4* 1
   1      .
   1     5* 1
```

```
Request:INPUT Y FILE E1P1

26 elements read into Y.

Request:BO .
```



```
Request:■
```


EDA

INTROSTAT PROGRAMS

0 (EXIT THE INTROSTAT PACKAGE)
1 PROGRAM 1
  * DESCRIPTIVE STATISTICS
  * CHI^2
  * STUDENT'S T-TEST
  * MANN-WHITNEY U TEST
  * WILCOXON MATCHED-PAIRS SIGNED-RANKS
  * ONE-,TWO-, AND THREE-WAY ANOVA
2 PROGRAM 2
  * CORRELATIONS
  * LINEAR & MULTIPLE REGRESSION
  * HIGH-RESOLUTION SCATTERPLOT
3 DATA FILE MGMT
  * FILE CREATION & UPDATING
  * VARIABLE TRANSFORMATIONS
4 RANDOM SAMPLER
5 LIST CASES
6 CATALOG OF DISKETTE
7 CONFIGURE SYSTEM

YOUR SELECTION:

PROGRAM 2

P392#20 DATA FILE	ALL CASES
DISPLAY 2 DECIMALS	PRINTER OFF
UNBIASED VARIANCE	AUTO SCALING

OPTIONS

0 RETURN TO HIGHER LEVEL MENU
1 SCATTERPLOT OF 2 VARIABLES
2 PEARSON CORRELATIONS
3 LINEAR REGRESSION
4 MULTIPLE REGRESSION
5 DATA FILE DIRECTORY
6 ALTER: VARIANCE EQN,OUTPUT FEATURES

YOUR SELECTION:

INTROSTAT-1

LINEAR REGRESSION
REGRESSION OF SCORE ON MINUTES STUDIED

Y = 63.75 + .14 * X

RESIDUAL STANDARD ERROR= 6.68
EXPLAINED/TOTAL VARIATION (R^2)= .63
S.E. OF SLOPE= .04

8 POINTS USED

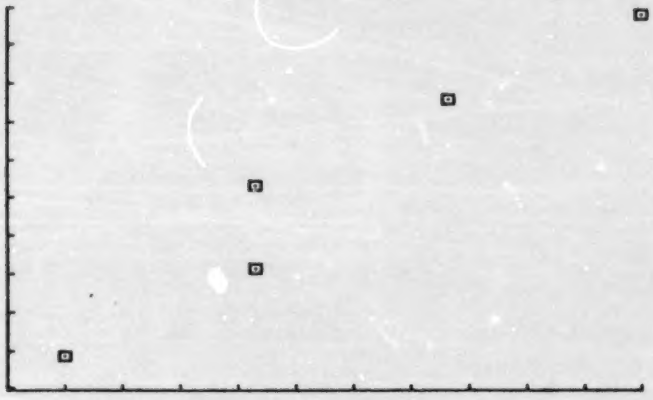
DO YOU WANT A PLOT WITH THE
REGRESSION LINE DRAWN? (Y/N):

X-AXIS=MINUTES STUDIED INTERSECT=0 TIC
KS=50
Y-AXIS=SCORE INTERSECT=0 TICKS=10

INTROSTAT - 2

```
::::::::::::::::::::::::::::::::::::
:  STATISTICAL PROCESSING SYSTEM   :
:                                  :
: S.P.S. 4.2       COPYRIGHT 1982 :
: REV. BY G.J. BUHYOFF & R.B. HULL:
::::::::::::::::::::::::::::::::::::
          DATA DISK ON DR#2
           PRINTER SLOT#1

  (1) FILE CREATION & MGT.
  (2) DESCRIPTIVE STATISTICS & PLOTS
  (3) CORRELATIONS
  (4) REGRESSION ANALYSES
  (5) MEAN TESTS ; T TESTS AND ANOVA
  (6) TEST DISTRIBUTIONS ; T,F,X2
  (7) R X C CONTINGENCY TABLES
  (8) MONTE CARLO DISTRIBUTIONS
  (9) MULTIVARIATE ANALYSES
  (10) UNIVAR,BIVAR & TRIVAR ANALYSES
  (11) PREPARE SPS FILES FOR MAINFRAME
  (12) RECONFIGURE DRIVE  & PRINTER


  <R> SELECTION


FILE= N=0 NV=0
FREE MEMORY=26148


(1) LIST & EDIT      (2) WRITE FILE
(3) SORT             (4) STRIP VARS.
(5) DELETE OBS.      (6) LIST (SCREEN)
(7) LIST(A)-PRINTER  (8) VAR. LABELS
(9) TRANSPOSE *      (10) TRANSFORM *
(11) CLEAR MEMORY    (12) ADD DATA *
(13) MERGE FILES *   (14) RANK DATA *
(15) RECODE *        (16) INDICES *
(17) UNIT VECTOR *   (18) REORDER OBS.*
(19) CATALOG         (20) S.P.S. MENU
(21) DELETE FILES    (22) LIST(U)-PRINT
(23) UNLOCK FILE     (24) LOCK FILE
(25) ROUND OFF

<CTRL><D>-RETURN  LOAD DISK FILE

<CTRL><N>-RETURN KEY IN NEW FILE


<R> OPTION NUMBER OR KEY SEQUENCE
```


SPS-1



X=HSGP Y=CGPA

(L)IST; (C)ONT

POINT BISERIAL CORRELATION
BETWEEN CTHG AND SMOKING

CORRELATION = .476962607

T VALUE = 2.54533268 WITH 22 D.F.

DESIRE ANOTHER CALCULATION (Y/N)

<U>=UP <D>=DOWN ->=RIGHT <-=LEFT

CORRELATION MATRIX

VAR:	HSGP	CGPA
V1:	1	.970725
V2:	.970725	1

PEARSON'S CORRELATION COEFFICIENT

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PRESS 'RETURN' AFTER EACH SCORE.

PAIR 1:	23	46
PAIR 2:	19	36
PAIR 3:	22	38
PAIR 4:	29	51
PAIR 5:	20	31
PAIR 6:		

SCORE 1: ?GO

TYPE GO AFTER LAST SCORE.

ITEM	SCORE 1	SCORE 2
N	5	5
MEAN	22.60	40.40
STD DEV	3.91	8.02
CORRELATION	0.8911	
SIGNIFICANCE ONE-TAILED	0.0204	

ENTER A=ANOTHER PROBLEM, E=EDIT DATA,
P=PRINTOUT, M=MENU, S=STOP.

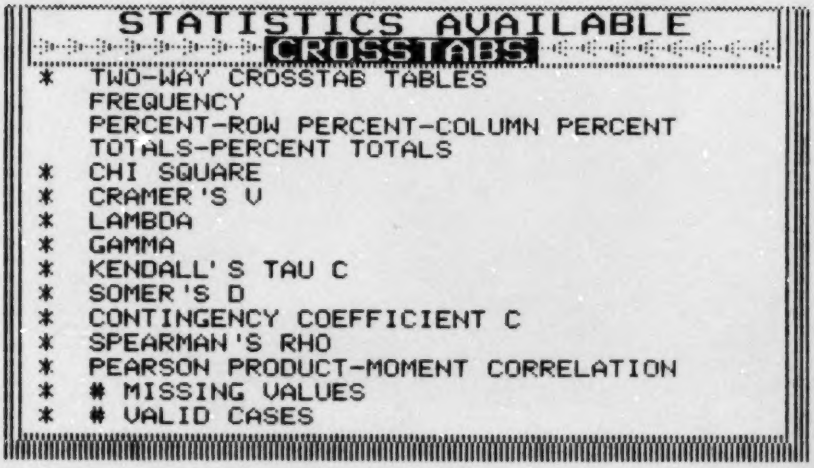
FINESSE

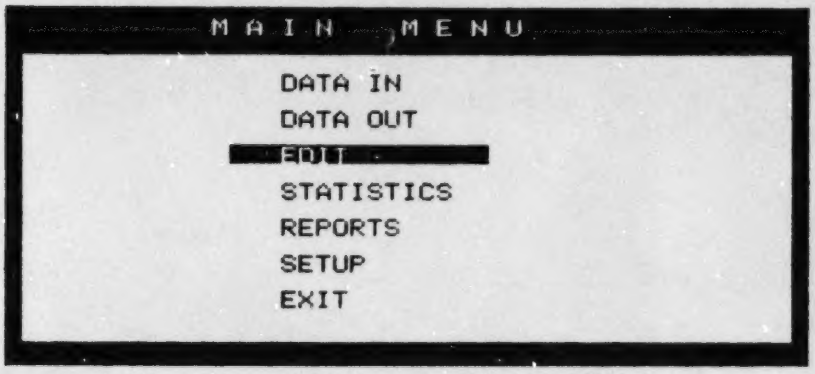
```
TYPE IN CORRELATION COEFFICIENT: .8911
        WHAT IS THE SAMPLE SIZE: 5
             SIGNIFICANCE LEVEL: .05

FISHERS Z =  1.4272    S.E. = 0.7071
                      ZCRIT =  1.9600

THE  95.0 % CONFIDENCE INTERVAL IS:

0.0413 < 0.8911 < 0.9928

- - - - - - - - - - - - - - - - - - - - -

TEST OF R = 0

FOR R= 0.891 AND  N=    5


T=   3.4011  WITH DF =    3

PROBABILITY GIVEN TWO TAILS IS  0.0407

ANOTHER CALCULATION (Y OR N)?
```


STATPAC (A)

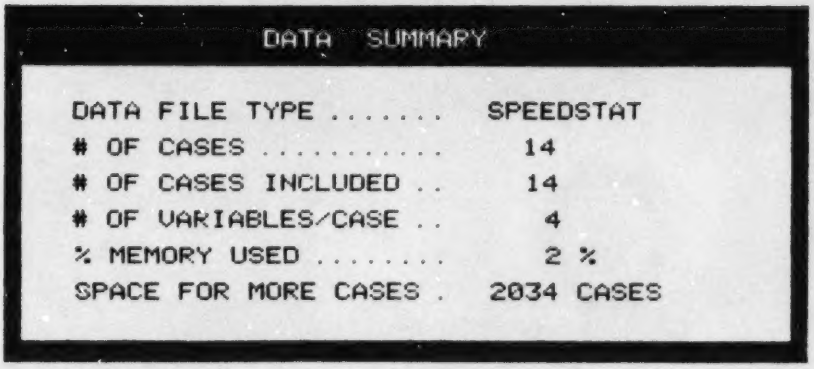
```
MAJOR EFFECT,PLANNED COMPARISON OR STOP
(TYPE M,P,OR S)
?M

ENTER NUM. LABEL FOR THE MAJOR EFFECT
?1


  SUMMARY OF THE HYPOTHESIS

* * * * * * * * * * * * * * * * * * * * *


MAIN EFFECT OF FACTOR 1(FACTOR1)


NULL HYPOTHESIS HBM=0,WHERE H=
1 0 0 -1
0 1 0 -1
0 0 1 -1


0 1 0 -1
0 0 1 -1


  SUMMARY OF HYPOTHESIS TESTING

* * * * * * * * * * * * * * * * * * * * *



SSH=82.2217032  DF=3  MSH=27.4072344

SSE=85.9321431  DF=22  MSE=3.9060065

EXACT F=7.0166894  DF=3,22  P=2.05225852
E-03


DO YOU WANT MARGINAL MEANS
(TYPE Y OR N)
?

?Y


MARGINAL MEANS (UNWEIGHTED)


1   5.38
2   8.40
3   6.14
4   3.00


MAJOR EFFECT,PLANNED COMPARISON OR STOP
(TYPE M,P,OR S)
?
(TYPE M,P,OR S)
?
```

GANOVA





PRESS --> TO MOVE CURSOR DOWN
PRESS <-- TO MOVE CURSOR UP
PRESS RETURN TO ENTER YOUR CHOICE


DATA SUMMARY
DATA FILE TYPE ..... SPEEDSTAT
OF CASES 14
OF CASES INCLUDED .. 14
OF VARIABLES/CASE .. 4
% MEMORY USED ..... 2 %
SPACE FOR MORE CASES . 2034 CASES

RTN : CONTINUE
ESC : QUIT

SPEEDSTAT

DATA SUMMARY

DATA FILE TYPE ..... SPEEDSTAT

OF CASES 46

OF CASES INCLUDED .. 46

OF VARIABLES/CASE .. 5

% MEMORY USED ..... 4 %

SPACE FOR MORE CASES . 2002 CASES

RTN : CONTINUE

ESC : QUIT

DISPLAY REPORTS

S P E E D S T A T C R O S

::::::::::::::::::::::::::::::::::::::

TABLE OF TEST1/PROF

BAR : MOVE WINDOW UP
--> : MOVE WINDOW RIGHT
<-- : MOVE WINDOW LEFT
RTN : MOVE WINDOW DOWN
ESC : QUIT

SPEEDSTAT - 2

```
REPORT: PREP

COMMAND: DEFINE B2 - YROPENED
ENTER LONGNAME: AGE OF STORE (YEARS)
ENTER SHORTNAME: AGE
ENTER LABEL: STORE/AGE/(YEARS)
ENTER FORMAT CODE: I8

NEW VARIABLE DEFINED.
A10        AGE              AGE OF STORE


COMMAND: SEE YROPENED,AGE
*PP*
```

	YROPENED	AGE
PHILADELPHIA GA	47.0	35.0
ROOSEVELT BLVD	49.0	33.0
ROOSEVELT BLVD	49.0	31.0
SIXTY-NINTH STR	51.0	31.0

```
ROW:    REGION (1=PHILADELPHIA, 2=CHICAGO, 3=WASH DC)
  BY
COLUMN: AGE OF STORE (YEARS)

ROW PERCENTAGES
```

	RECENT	ESTABLISHED	ORIGINAL	TOTAL
PHILADELPHIA	30.00	20.00	50.00	100.00
CHICAGO	33.33	16.67	50.00	100.00
WASHINGTON, D. C	36.36	54.55	9.09	100.00
TOTAL	33.33	33.33	33.33	100.00

```
ROW:    REGION (1=PHILADELPHIA, 2=CHICAGO, 3=WASH DC)
  BY
COLUMN: AGE OF STORE (YEARS)

COLUMN PERCENTAGES
```

	RECENT	ESTABLISHED	ORIGINAL	TOTAL
PHILADELPHIA	33.33	22.22	55.56	37.04
CHICAGO	22.22	11.11	33.33	22.22
WASHINGTON, D. C	44.44	66.67	11.11	40.74
TOTAL	100.00	100.00	100.00	100.00

DSS/A-2

ROW: REGION (1=PHILADELPHIA, 2=CHICAGO, 3=WASH DC)
BY
COLUMN: AGE OF STORE (YEARS)

PERCENTAGES OF GRAND TOTAL

	RECENT	ESTABLISHED	ORIGINAL	TOTAL
PHILADELPHIA	11.11	7.41	18.52	37.04
CHICAGO	7.41	3.70	11.11	22.22
WASHINGTON, D. C	14.81	22.22	3.70	40.74
TOTAL	33.33	33.33	33.33	100.00

THE CHI SQUARE VALUE IS: 5.85
DEGREES OF FREEDOM: 4

ACTIVE FILE STATUS COMMANDS:

1. STATUS (STAT)
2. VARIABLES (VAR)
3. SEEDATA (SEE)

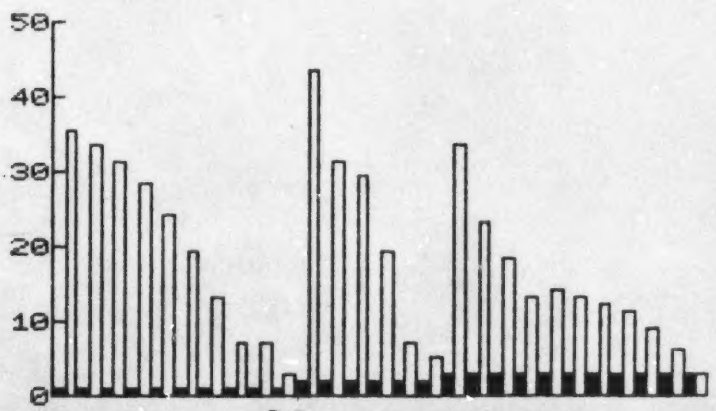
STATISTICAL ANALYSIS COMMANDS:

1. DESCRIBE
2. NTILES
3. WTILES
4. FREQUENCIES
5. CROSSTAB
6. WAVERAGE
7. CORRELATE
8. REGRESS
9. ANOVA

MODE SELECTION COMMANDS:

1. PREP
2. REPORT
3. GRAPHICS
4. DBADMIN
5. CONTINUE
6. END

STATISTICS:



DSS/A-3

PP

SOME OF THE BASIC OPERATIONS OF TSP ARE:

DATA A TIME SERIES EDITOR FOR ENTERING, EXTENDING AND CORRECTING TIME SERIES DATA.

GENR FOR COMPUTING A NEW SERIES, BASED ON A FORMULA OF VIRTUALLY ANY COMPLEXITY

PLOT TO PRODUCE HIGH-RESOLUTION PLOTS OF TIME SERIES, GRAPH TO PRODUCE HIGH-RESOLUTION SCATTER DIAGRAMS, SHOW TO DISPLAY SERIES ON YOUR SCREEN, AND PRINT TO PRINT SERIES ON YOUR PRINTER.

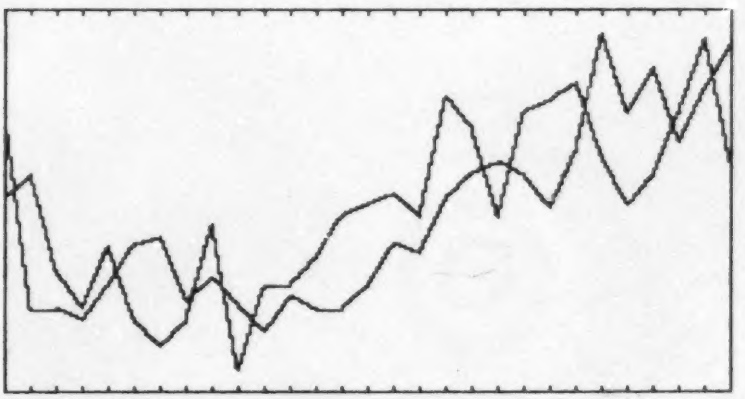
STORE TO STORE INDIVIDUAL SERIES ON DISK AND FETCH TO RETRIEVE THEM. SAVE TO SAVE ALL DATA FROM A SESSION IN A DISK FILE SO THAT THE SESSION CAN BE RESUMED IN THE FUTURE.

```
                    MICRO TSP 3.2
-----------------------------------------------
 COPYRIGHT (C) 1982  MCGRAW-HILL, INC.
-----------------------------------------------

WORK FILE CONFIGURATION:
-----------------------------------------------

WILL YOUR DATA BE DATED ? YES

FREQUENCY ? (A,Q,M) A

STARTING DATE  = 1950

ENDING DATE    = 1980

MAXIMUM SERIES = 118
```

TSP RESPONDS BY TELLING US THAT UP TO 118 SERIES OF 31 OBSERVATIONS EACH CAN BE HELD IN A REGULAR TSP WORK FILE

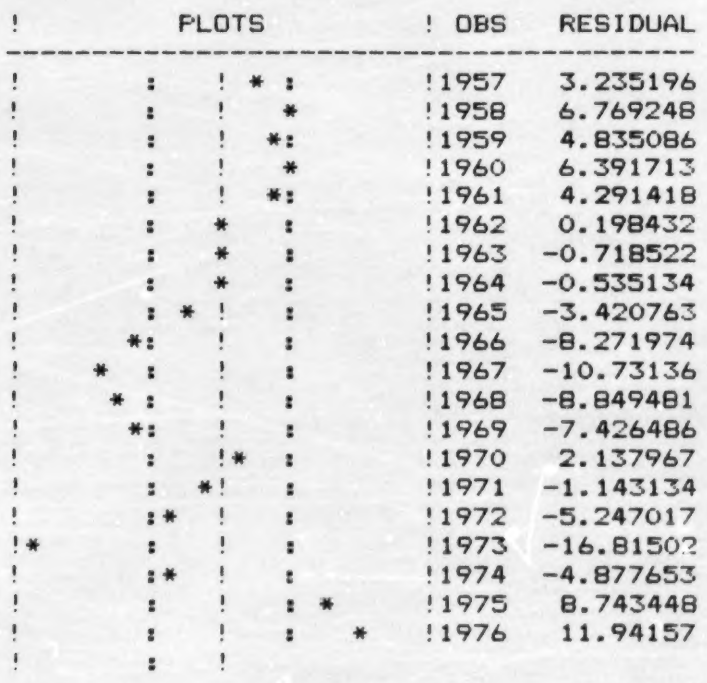
TSP-1

OBS	P	LP	INFL
1952	57.92000	5.380358	1.453844
1953	58.82000	5.436774	1.553867
1954	59.55000	5.462983	1.241074
1955	60.84000	5.536152	2.166246
1956	62.79000	5.583496	3.205128
1957	64.93000	5.636217	3.408186
1958	66.04000	5.668155	1.709533
1959	67.60000	5.739149	2.362204
1960	68.70000	5.783517	1.627218
1961	69.33000	5.814130	0.917030
1962	70.61000	5.872681	1.846242
1963	71.67000	5.925858	1.501203
1964	72.77000	5.992713	1.534812
1965	74.36000	6.064715	2.184966
1966	76.76000	6.142252	3.227541
1967	79.06000	6.195017	2.996352
1968	82.54000	6.285811	4.401720
1969	86.79000	6.366126	5.149018
1970	91.45000	6.432457	5.369282
1971	96.01000	6.510555	4.986331
1972	100.0000		



SMPL 1951 - 1980 // MDOT INFL

BP-2



PLOTS	OBS	RESIDUAL
	1957	3.235196
	1958	6.769248
	1959	4.835086
	1960	6.391713
	1961	4.291418
	1962	0.198432
	1963	-0.718522
	1964	-0.535134
	1965	-3.420763
	1966	-8.271974
	1967	-10.73136
	1968	-8.849481
	1969	-7.426486
	1970	2.137967
	1971	-1.143134
	1972	-5.247017
	1973	-16.81502
	1974	-4.877653
	1975	8.743448
	1976	11.94157

SMPL 1951 - 1979
TSLS // DEPENDENT VARIABLE IS CONS
INSTRUMENT LIST: C MDOT M INFL-1 TIME

	COEF	S.E.	T-STAT
C	3.792148	3.825328	0.991326
GNP	0.634776	0.012592	50.40808
INFL	-3.082539	3.591593	-0.858265

R-SQUARED = 0.99964
ADJUSTED R-SQUARED = 0.99961
OBSERVATIONS = 29
SUM OF SQUARED RESIDUALS = 1317.473
S.E. OF REGRESSION = 7.118430
DURBIN-WATSON STATISTIC = 0.88953
F-STATISTIC = 36477.2

COVARIANCE MATRIX ? (P,S,<CR>)

BP-3